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THE PURPOSE AND SPIRIT OF THE UNIVERSITY[1]

MODERN students of human nature have changed the old saying, "Many men, many minds," into the new dictum, "One man, many selves." There is much talk of multiple personality. Our complex modern life reflects itself in a composite person. A man is said to have as many selves as there are social groups of which he feels himself a member. To maintain a business self which can look a moral self straight in the eye, to have a theological self on good terms with a scientific self, to keep the peace between a party self and a patriotic self, to preserve in right relations a church self and a club self—such are the present problems of many a man or woman. One way to escape embarrassment is to invite at a given time only congenial and harmonious selves, and to banish from the company the selves that are discordant and disconcerting. The strong soul is he who can summon all his selves into loyal team play. Personality is the name men give to this unity of the self, and purpose is the organizing principle. Only as many groups of thought and feeling are schooled into cooperation by a well-considered, steadfast aim can a man be master of a single self. To be sure, unity of a sort can be achieved by one who has a meager company of selves. Narrowness, provincialism, bigotry, describe a personality in which unity of purpose is won at a sacrifice of breadth, outlook and sympathy. The highest type of personality grows out of many far-reaching selves which have

[1] Commencement address of the president at the University of Wisconsin.

been selected and organized into unity by a dominant purpose. It is no easy task to unify often divergent and conflicting impulses, habits, memories and ideals into a harmonious hierarchy of aims. But such singleness of ideal and effort creates power. The man of purpose is not to be resisted. Every instinct and habit, every picture of the mind, every effort of the will, every emotion, fits into his scheme of things. He never wanders from the path which leads toward the end he has set up. He turns every opportunity to account. He foresees problems and is prepared to meet them. He confronts difficulties undaunted. He is master of a company ever devoted and responsive to command. The world submits to great men of single aim.

Education seeks just this unification of personality. Plato's philosopher was he in whose life reason aided by will kept appetite and passion in servitude to the higher aims of life. Sir Richard Jebb tells us that

> Education consists in organizing the resources of the human being. It seeks to give him powers which shall fit him for his social and physical world. . . . The educated person is able to deal with circumstances in which he has never been placed before. He is so because he has acquired general conceptions. His imagination, his judgment, his powers of intelligent sympathy, have been developed.

The ideal personality, then, includes many selves organized by a masterful purpose and unified by a spirit of harmony.

In many ways a human group, a family, a community, an institution, a nation, is like a personality. Hobbes saw the state as a vast Leviathan. Comte conceived humanity as an on-going continuous life which sweeps through the centuries. Bluntschli endows political society with the characteristics of a person. Contemporary philosophers attribute to society the mental and moral traits of a vast super-man. The analogy is not wholly fanciful. Just as purpose unifies the individual, so a common aim gives the human group a sense of solidarity. Social consciousness is the well-worn term for this thrill of comradeship. The sense of team play that makes the eleven or the nine an efficient unit gives us the type. Each individual sees the group as a whole, is aware of his own relation to it, knows that his fellows share his feeling, and counts upon them to act promptly for a common end. A group which can not control its members and rally them in loyalty to a single aim lacks solidarity and effectiveness.

So, too, a large inclusive group like the nation must subordinate the minor groups that make it up, must rally them to the service of the whole, must provide the ideals and the plans for gaining a national end. The story of modern Germany is eloquent of imperial purpose and of aims unswervingly pursued. Contrast the broken, humiliated German states after the battle of Jena with the unified, efficient triumphant empire of to-day. The names of von Stein, von Moltke and Bismarck spell purpose and policy, far-seeing, statesmanlike, remorselessly followed. These aims seem like vast independent forces, molding men and institutions to their service. Schools, army discipline, scientific research, technical skill, commercial resourcefulness, governmental efficiency, social legislation, are all well considered parts of one comprehensive, far-reaching national program. Against such a power a disorganized, untrained and undisciplined nation is impotent. The law of unification through purpose holds good whether the units be the impulses, thoughts and feelings of the individual, or the persons and groups that make up a great people. As we classify the powers

of the world we may value them for their contributions to the past, but their futures we measure in terms of social unity and national purpose. To a despondent observer our own nation at times appears to lack both unity and a clear vision of its task. Sections, classes, interests, parties, cliques, sects seem to the gloomy onlooker to give the lie to the idea of national unity. Faith in a glorious manifest destiny is not the same thing as a real sense of national purpose. But beneath all the discord and clash of antagonistic groups, and vaguely emerging from a fatalistic optimism, we discern an underlying loyalty to American ideals and a clearer conception of American aim and American duty. Our national greatness will depend upon the growth of loyalty and good will, and upon the working out of an ever clearer conception of America's part in the building of a nobler civilization.

As with the nation, so with the institution. Consciousness of itself, a sense of team play, loyalty to a common aim, make a university strong and efficient. But the university gets its meaning from society and from the nation and therefore must be an expression of the common life. In the words of Dr. Pritchett, "No nation is likely to be educationally efficient until it has grown into some fair possession of a national educational consciousness." The university is one of the agencies of national purpose. "The kings," writes President Jordan, "have recognized the need of universities and university men. In this need Alfred founded Oxford, and Charlemagne the University of Paris. The Emperor William is quoted as saying that 'Bismarck and von Moltke were but tools in the hands of my august grandfather.' To furnish more such tools and in all the range of human activity, the University of Berlin was established."

If the university, as an organ of society, is to gain strength of purpose it must have a consciousness of its function and duty. Only by such sense of team play can individuals, departments, schools, colleges, faculties, classes, student groups, be fused into genuine unity and rallied to a common loyalty. In general, the university ideal is changing from the thought of personal privilege to the conception of social service, from a preaching of personal culture to a democracy of studies, or in another phrase, from culture to efficiency. This does not mean that colleges and universities have not always had some sense of social obligation. But too generally the privileges of higher education were for the favored few who by virtue of their special opportunities were set off from the masses of men. The growth of democracy has made new demands, has widened opportunity, has broken down the barriers of class. Even in the old world, and notably in the new, democracy has created schools, colleges and universities and has chartered them to serve the common welfare. The university has become, therefore, especially in this mid-western region, "the people's organized instrument of research," or as President Van Hise puts it, "the scientific adviser of the state." On every hand we hear variations of this central theme of social service. College presidents and men in political life, each group from its own point of view, insist upon this conception of higher education. In this view the university appeals to the imagination, it becomes an organ of the higher life of the community and the state, it connects itself at every point with the industry, commerce, social conditions, educational interests, ideal purposes of the commonwealth.

The university as a social agent is entrusted with certain standards of the community, standards of scientific method and

of truth, standards of technical efficiency, standards of cultural attainment, standards of personal character and of civic duty. It is only through the creation, the guarding, the elevation of these standards that material and spiritual progress is possible. The university becomes a trustee of ideas and ideals, a custodian of standards. In the administration of these standards the university can not sacrifice the common welfare to individual need or desire. It must exclude those who fail to meet the standards of attainment and character which the university administers. Favoritism, faltering, compromise, cowardice mean betrayal of a social trust. Nor may the standards of the university be provincial and temporary. In the words of President Hadley, "the university must be judged by the standards which have held for all time rather than those of a single generation, or of a single profession." The imagination kindles at this thought of a university exalting the tests of truth and character by which society slowly gropes toward higher levels.

When the mind is possessed by this vision of the university, all the careers for which it provides training take on the dignity of social worth. Vocations which have been thought of as individual widen into literal calls to be servants of the common life. The office of the teacher, the function of the physician, the work of the engineer, get their higher meaning from their value to the community. The profession of the law, so often thought of as a field for personal exploitation, is in its true significance a social service. "We lawyers," declares Woodrow Wilson, "are servants of society, officers of the courts of justice . . . guardians of the public peace, . . . bond servants of the people." The scientific farmer is in one view seeking personal gain, but in a much deeper sense he is diffusing knowledge and skill and is raising into higher esteem fundamental industry which makes modern society possible. The college graduate who has received the training men are fond of calling liberal, may no longer regard himself merely as a member of a privileged class. In the new spirit of *noblesse oblige* he must recognize his obligation to his fellows and to the community; must remember that "life is not a cup to be drained, but a measure to be filled." Such is the ideal purpose which summons the modern university to unity and comradeship in the service of the common life. When this vision fills the minds of all, when it controls their conduct, when it stirs their emotions and carries them steadily forward to loyal achievement, then the university gains an irresistible power and becomes a true expression of the higher purposes of the state, the nation and mankind.

As a general purpose, a settled character, a dominant spirit control the thoughts and impulses of the person, so the persistent aim and the enduring ideals of an institution influence and guide the individuals who compose it. The trustees of a university that is unified by the purpose of service must think of themselves as public officers entrusted with grave duties and heavy responsibilities. No personal ambition or interest can enter where the spirit of trusteeship for the common welfare is the controlling ideal. Strong, resourceful men may well sacrifice their personal interests in responding to so high a summons. To administer a university wisely, with open mind to the public welfare, with sympathetic insight into the needs and inspirations of all classes of citizens, to safeguard academic freedom, to guarantee positions of dignity and satisfying activity to competent scholars—these are the duties and

opportunities of men who accept a great educational trust.

Devotion to the common good lays upon members of the investigating and teaching staff duties they may not shirk. To maintain worthy standards of scholarship, to be loyal to these ideals, to be faithful to the pursuit of truth, to conceive education in its widest and most generous aspects, to have sympathetic insights into the lives of their students, to spend themselves freely for the community—to these things the vision of the university as a public servant must draw the teachers and the investigators of a true university. This is the call to the "scholarship whose devotees regard themselves as holding a trust for the benefit of the nation."

The university fails of its purpose if its students do not catch the inspiration of the common ideal. To generous-minded young men and women this thought of the university must make appeal. It is the duty of the institution to fix this image of the university in the imaginations of its students. From the day they enter to the day they leave, this dominant purpose, this persuasive spirit should grow ever more potent and fascinating. It would be well if students could begin their college life with formal ceremony so that at the very outset they might feel more keenly the social obligations they are assuming. Admission to the university should seem to them initiation into a high calling. It is a pity that they should begin for the most part thoughtlessly or with minds fixed solely upon personal aims and plans. The state is calling them to her service. She has a right to insist that only those who are in earnest, who have at least a dawning sense of social duty, should seek admission to the public training which can be justified only by its service to the state. It should be made clear that no one has the right to demand admission as a personal privilege. Conformity with technicalities of entrance must not blind us to the moral obligations involved. Out of the common fund to which all citizens contribute the state erects and maintains not for personal advantage but for public good this West Point of science, the arts and the professions. Every matriculant, therefore, by virtue of admission is honor bound to meet the state half way in her desire to prepare soldiers of science for the battles of peace. The university must unhesitatingly rid itself of individuals who are indifferent to intellectual work or hostile to it. After fair test, those who fail to show their sense of the university's purpose must be dismissed. This is necessary not only in justice to the state, but in fairness to those who show due appreciation of their opportunities and duties.

The dominant university purpose gives a proper setting to the activities of student life and to the standards and conduct of the groups into which the student community naturally falls. The contacts of daily association and searching tests of comradeship, the discovery and development of leadership, the give and take of social intercourse, the healthy recreation of undergraduate life—all constitute an environment which may afford admirable discipline. There is large truth in the assertion that the university is the world in miniature and that it offers a social training which will be turned to account in the wider life of the community. But all these activities must be tested by the dominant purpose of the university. The question must always be, is this or that out of harmony with the ideal of the university as an organ of the common life? Does this student demonstration or that rollicking festivity create in the public mind the feeling that the university is living for itself

and not for the community, does it foster the belief that the university is not dominated by the motive of service; does it create the suspicion that students ignore or forget their duty to the state which is making their self preparation possible? This is a vital question. So with the student groups that play so large a part in academic communities. Are these groups working loyally for the common welfare, have they due regard for the fundamental things of university life, are they actuated by a sense of responsibility for their members, do they cultivate tolerance, justice and good-will? These are questions which individuals and groups must constantly put to themselves and answer frankly and honestly. The good name of the university is safe only when its members feel an obligation to further the common purpose to make the university a true organ of the whole people.

So long as this spirit prevails, no sense of arrogance, of exclusiveness, of privilege or caste will enter the minds of its members. The old distinction of "town" and "gown," the traditional attitude of superiority toward those outside the walls of the academic cloister, these things have no place in an institution dominated by the spirit of social service. Every man and woman of the commonwealth becomes in this view a supporter and patron of the university, and may expect from it good-will and loyal service. If to say that the university belongs to the state is anything more than phrase-making, every member who has imagination, the power to see the institution in its real relationships, must feel the genuine humility of one who would faithfully serve his fellows.

If the university is to fulfill its function, it must carry conviction to the people of the commonwealth. It must impress them with its purpose, make them see it as a faithful agency of the people. The men and women of the state must not think of the university as an institution which, because it has public support, should lower its standards to admit the weak, indifferent or incompetent, or to graduate those who have failed to reach the minimum of attainment. People must not think of the university as a place in which personal influences can secure special privilege. Rather they must regard it as fearlessly loyal to the common welfare, true to high standards of scholarship, truth, efficiency, character and judgment. They must not ask or expect special favors from this servant of the whole democracy.

If the university purpose is to be achieved the institution must seek special ability wherever this is to be found. It would be a calamity if only sons and daughters of the rich and well-to-do could gain access to higher training. Talent and genius ignore the distinctions of wealth and class. A way must be found by which young men and young women of great promise, however they may be hampered by poverty, may gain access to the social training of the university, and be freed in large part or wholly from the self-supporting work which makes the best scholarship impossible. We must believe that men and communities will catch this vision of the university and by providing scholarships see to it that no exceptional ability shall be deprived of development for the service of the commonwealth. The university would lose its power and its ideals if it ever became a place of privilege for the well-to-do and not a training school for all who have talents and capacities for which the state has need. The controlling ideal, the mastering purpose of the university, therefore, is not a mere phrase or conceit; it is a guiding principle which finds application to every individual, to every group,

to every activity of academic life, and organizes these into the strength and unity which only a common aim can confer.

Purpose steadily pursued creates a persuasive spirit, registers itself in institutional character. Open-mindedness must be a conspicuous trait of a true academic community. The very search for new knowledge, the effort to see the relations of things, presupposes an attitude of enquiry, a willingness to look at an idea or a fact from many different standpoints. Open-mindedness toward truth merges into tolerance and mutual respect as between the individuals and groups who make up the university. Narrowness or prejudice, a patronizing attitude of one group toward another, the discrediting of this calling as compared with that, the limiting of the conception of research to traditional fields of enquiry—these things have no place in an institution mastered by a sense of loyal duty to commonwealth and nation. Genuine culture consists largely in sympathy with many kinds of men and in insight into the widest ranges of human life. To live in a highly specialized community and to enter with appreciation into the activities of one's colleagues in many fields is in itself a liberalizing experience. There is place for generous rivalry in a great university, but this rivalry must be kept on a high level and not allowed to sink into unworthy conflict and discord. Open-mindedness, tolerance, high-minded rivalry can not fail, under the guidance of a controlling ideal, to fuse the university into a genuine unity of comradeship and goodwill. When each man and each group can see, not only through its own eyes but through the eyes of other persons and groups, the common problems of the institution, there must develop a keener sense of team play, a quickened loyalty, a more vivid corporate consciousness.

The university, a servant of the common life, exalting standards of efficiency and worth, summoning its members to a common task, must stand for the loftiest ideals. It must inspire enduring faith. It must exalt character above technical skill, mental alertness, refinement of feeling. It must lay hold of the fundamental motives. The university rightly aims at leadership, but in the words of Dr. Pritchett, it can win this "only by inspiring the youth of the democracy with a true, vibrant living faith. . . . The American university is today the home of that faith. It is the faith of humanity in humanity . . . and the American university, which embodies the intellectual aspirations of a free people, is becoming day by day the representative of their spiritual aspirations as well." The state university can not fulfill its true function unless it rises to the higher level of spiritual idealism. It may not ally itself with any church or support any one theology, but it must draw its inspiration from an essentially religious view of life. As the Sir Thomas More's Utopians tolerated many theologies of widely varying kinds, but united in common worship of the divine energy back of all nature and human life, so the university welcomes men and women of many faiths and rallies them to a devoted loyalty to common ideals of duty, service and reverent aspiration.

In the "Republic" Socrates, in talking of testing the young for leadership, declares, "We must inquire who are the best guardians of their own conviction that the interest of the state is to be the rule of all their actions. We must watch them from their youth upwards and propose deeds for them to perform in which they are most likely to forget or be deceived, and he who remembers and is not deceived is to be selected, and he who fails in the trial is to be rejected." The gentle sage goes on to

describe the tests of toil and pain, the tests of fear, the tests of seductive pleasures, and he tells us that "He who at every age as boy and youth, and in mature life, has come out of the trial victorious and pure, shall be appointed a ruler and guardian of the state. He shall be honored in life and death, and shall receive sepulcher and other memorials of honor, the greatest that we have to give."

The essentials of life and character have not changed since the days when Socrates talked of truth and justice in the groves of Academus. You graduates to-day go forth to be tested. You have in varying measure the vision of the university, the sense of obligation which your training lays upon you. You must hear, be it ever so faintly, the call to be servants of the commonwealth. Put to yourselves the question which comes down through the centuries, can you hold to this conviction that the interests of the community should be the rule of all your actions. You will face intellectual sophistry and beguiling fallacies. Have you the keenness of mind and the force of character to analyze these specious assertions and to hold steadfastly to things that are true and enduring? You will be tested by fear, fear of financial loss, fear of ridicule, fear it may be of social ostracism. Have you the courage and character to preserve your convictions of loyalty to the general good? You will be lured by pleasure, dazzled it may be by luxury and ostentation, tempted to self-indulgence and evanescent pleasures. Have you the fiber to resist these appeals and to remember that the social servant must be ever strong, clear eyed and faithful to his work?

May you hold to the vision you have caught: may it with the passing years grow ever clearer, brighter, more commanding in your lives. The university sends you forth to-day with God speed, entrusts to you the good name of our widening community, summons you to loyalty, urges you to organize all your resources of mind and spirit into the unity of a high aim, the firm resolve to realize in your own lives the masterful purpose of the university which is to be in ever fuller measure at once the standard bearer and the servant of the state.

Go to your work and be strong, halting not in a world of men,
Balking the end half won for an instant dole of praise.
Stand to your work and be wise—certain of sword and pen,
Who are neither children nor Gods, but men in a world of men.

George E. Vincent

COURSES IN HIGHER PURE MATHEMATICS

The number of the objects of mathematical thought is infinite and the rapidly widening range of developed mathematics is continually directing mathematical attention to objects which were previously either practically or entirely ignored. Efforts to classify mathematics have been only partially successful and it is extremely difficult, in many cases, to draw reliable conclusions as to the nature of a course from its title. Hence the efforts to ascertain from the announcements of the leading universities of the world the relative emphasis which different countries place on the various subjects of higher mathematics can not be expected to lead to entirely trustworthy results.

The rapid development of our universities has led to such a rapid increase in the number of different mathematical courses beyond the first courses in differential and integral calculus, that many well-educated people have failed to keep informed as regards the general meaning of the titles of some of these courses. This is perhaps not surprising in view of the fact that several of our strongest universities offer their advanced courses under more than thirty different titles.

This great number of titles of courses implies that many of them are devoted to comparatively narrow fields and raises the question whether we are not in danger of specializing too much and of depriving our students of a thorough training in the more general and fundamental methods of wide contact. It would probably be generally conceded that we have gone further in the line of special courses than the universities of Germany, which were pioneers in this direction. On the other hand, it may be observed that the large German and French mathematical encyclopedias which are in the course of publication treat pure mathematics under about one hundred general headings, each of which would be sufficiently extensive for a course suitable for graduate students.

This great extent of available material makes it impossible for one student to cover even superficially the entire field during his college days and hence it tends to increase his interest in a wise choice of his courses, especially as regards such courses as are most generally given and are most likely to be very useful in his later mathematical development. One of the most reliable sources of information along this line is furnished by the number and the extent of the courses devoted to different subjects in the various leading universities.

Various journals, including the *Bulletin of the American Mathematical Society,* are publishing, from time to time, lists of announcements of the courses offered by a large number of different universities of Europe and America. A comparative study of these announcements for a period of years involves a large amount of labor in view of the changes from year to year and the uncertainty as to the real significance of some of the titles. As American mathematical activity has been so largely influenced by Germany, especially during recent years, and as the University of Berlin occupies such a prominent place among the greatest centers of learning, it may be fitting to begin with some results drawn from the announcements of this university during the last six years.

The following table gives only those courses in pure mathematics to which the equivalent of at least twelve lecture hours for one semester have been devoted during the last six years. A large number of special courses have thus been excluded. For instance, one of the courses offered only once during the period covered by the table bears the title, "Transcendental Nature of π and e," another is announced under the title "Influence of Euler's Work on Modern Mathematics," while still another bears the title "Problems in Maxima and Minima treated by Methods of Elementary Geometry." No course bearing the title "Differential Geometry" was offered at Berlin during the period under consideration, and only one course entitled "Linear Substitutions." A large part of the subject matter of such courses was, of course, given in the courses under more general titles. Similar remarks apply to a large number of other subjects. The number of hours devoted to seminars and colloquia was not included in the following table as the subject matter of these exercises was not always clearly announced.

BERLIN UNIVERSITY

Subjects	Lecture Hours for Six Years	Totals
Curves and surfaces	4, 11, 8, 8, 8, 13[1]	52
Theory of functions	4, 6, 0, 8, 10, 12	40
Determinants, theory and applications	4, 8, 4, 4, 8, 6	34
Theory of numbers	4, 4, 8, 8, 4, 2	30
Elliptic functions	4, 4, 4, 8, 8, 2	30
Algebraic equations	0, 4, 8, 4, 6, 4	26
Differential equations	0, 4, 6, 4, 6, 4	24
Algebra	4, 4, 0, 4, 0, 4	16
Calculus of variation	0, 4, 4, 0, 0, 4	12

It may be observed that the total number of hours devoted to the four subjects belonging to arithmetic and algebra is 106, while the total numbers of hours devoted to analysis and geometry are 98 and 52, respectively. As we shall see later, these results are not in accord with those obtained in a similar man-

[1] The last of these numbers applies to the current year, and the numbers which precede relate to the preceding years in order.

ner from many other universities and they would be slightly changed at Berlin if all the courses in pure mathematics had been tabulated. They would also have been affected by the consideration of the courses on applications of mathematics. As is well known, a large number of courses on applications of elliptic functions are given at Berlin. These are in addition to the courses on the theory of these functions as listed above, and during the six years under consideration the number of lecture hours devoted to these applications in Berlin University were, respectively, 6, 0, 10, 0, 8, 4—making a total of 28. Hence a total of 58 lecture hours for a semester were devoted to elliptic functions and their applications during these six years—an average of nearly five hours for each semester.

Among the other German universities which maintain very strong mathematical departments Göttingen should perhaps be especially mentioned in view of the facts that so many Americans have studied there and the influence of Klein and Hilbert has been so great in shaping our courses in higher mathematics. It may also be desirable to bring the mathematical courses of the universities of Berlin and Göttingen together in view of the fact that they exhibit a great difference as to emphasis on the various subjects of pure mathematics. For instance, only two courses on determinants and their applications were given at Göttingen during the last six years while at Berlin this course has been given very frequently, as may be seen from the table given above.

At Göttingen courses on differential equations have been given very much more frequently than at Berlin, while courses on elliptic functions are much more common at the latter institution than at Göttingen. Judging from the number and the extent of the courses, there is a very wide difference between Berlin and Göttingen as regards the emphasis on the subjects which are usually classed under the general headings, algebra and analysis; or arithmetic and algebra, and analysis. At Berlin the former receive very much more attention than at Göttingen and the predominating influence of the latter institution is evident in the advanced mathematical courses of many American universities. A marked difference between Göttingen and Berlin may also be observed with respect to the tendency to give courses under a large variety of names. At Göttingen we find a larger number of courses under such titles as, encyclopedia of geometry, encyclopedia of elementary mathematics and elementary mathematics from a higher standpoint, than at Berlin.

In the following table we give again only those courses to which at least twelve lecture hours for one semester have been devoted during the last six years, excluding courses which appeared to have been devoted mainly to applications, and arranging the others in the order of the number of lecture hours.

GÖTTINGEN UNIVERSITY

Subjects	Lecture Hours for Six Years	Totals
Differential equations.....	12, 12, 12, 8, 11, 4	59
Theory of functions.....	7, 0, 8, 6, 10, 8	39
Descriptive geometry.....	4, 4, 0, 8, 0, 8	24
Algebra.....	4, 0, 4, 4, 4, 4	20
Theory of numbers	4, 0, 2, 4, 3, 4	17
Calculus of variations.....	4, 4, 1, 4, 0, 2	15
Curves and surfaces	7, 4, 2, 0, 0, 0	13
Principles of mathematics	0, 0, 4, 2, 2, 4	12

A comparative study of the courses offered in other German universities reveals wide differences as regards emphasis on the various subjects and such a study tends to explain the migration of students from one institution to another. Unfortunately, there is very little migration in American universities, and hence our students are frequently acquainted only with the courses offered by one institution. This makes it the more desirable that our large universities should aim to offer a wide range of subjects, covering the most important parts of the various developed fields of mathematics. It is evident, however, that it would be much better if our students could be induced to divide their time of graduate study among different universities and to seek instruction under the foremost men along the lines of their chief interests.

It is of great interest to consider the difference between the emphasis placed on various subjects by different countries. A comprehensive study of this difference becomes, however, quite difficult in view of the fact that the different countries vary widely as regards the line of division between their university courses and those treated earlier. It is, however, not difficult to establish certain decided differences. A slight study reveals the fact that American universities are unusually weak, on an average, with respect to courses on elliptic functions, general mathematics and theory of numbers; while the relative number of our courses in the theory of groups, theory of functions, and differential geometry is above the average. These results are deduced from a fairly extensive tabulation of the courses in mathematics which Professor J. B. Shaw recently presented before the Mathematical Club of the University of Illinois. In particular, Professor Shaw listed the courses of all German universities for a period of six years and found that during this period the number of lecture hours devoted to courses in the three great fields of pure mathematics—algebra, analysis and geometry—were in the proportion 193, 259 and 200, respectively.

G. A. MILLER

UNIVERSITY OF ILLINOIS

WILLIAMINA PATON FLEMING

MRS. WILLIAMINA P. FLEMING, curator of astronomical photographs at the Harvard College Observatory, was born in Dundee, Scotland, on May 15, 1857, and came to this country soon after her marriage in early womanhood. She soon drifted into the work which was destined to occupy her life, by undertaking some simple astronomical calculations at the Harvard Observatory, where, upon her death on May 21, 1911, she had just completed thirty years of service. These thirty years have covered a period of remarkable changes in the methods of attacking astronomical problems. The prism has revealed to us something of the nature of the heavenly bodies, and the photographic plate has made a permanent record of the condition of the sky, which may be studied at any time. Celestial photography was systematically undertaken at Harvard in 1882, by Professor E. C. Pickering, the present director. The work was placed on a firm basis by the liberality of Mrs. Draper in establishing the Henry Draper Memorial, and in a short time, photographs were being taken in large numbers. The Harvard photographic library now contains over 200,000 plates.

Mrs. Fleming's duties were to qualify these plates, superintend their care, examine them for peculiar objects, and make investigations by means of them. Each plate must be so indexed that it can be found at any time, and must be carefully handled and stored, being of fragile glass, and without a duplicate. With a naturally clear and brilliant mind, Mrs. Fleming at once evinced special aptitude for this photographic investigation, which was so novel that precedents could not be found for its execution, and, in return, the photographs proved to be veritable mines of wealth for the extraction of information concerning the sidereal universe. Most of Mrs. Fleming's discoveries were made from the spectrum plates which are taken by means of a prism placed before the object glass of the telescope, and which often show the spectra of several hundred stars. She examined with a magnifying glass, all these plates taken at Cambridge and at the Harvard southern station in Arequipa, Peru, and marked all objects showing any peculiarities in their spectra. In this way, she found ten new stars and more than three hundred variable stars, because of the presence of bright lines in their spectra. She classified the spectra of 10,351 stars, which were published in 1890 in a volume of the *Harvard Annals*, called the "Draper Catalogue of Stellar Spectra." When stricken with the fatal illness, she was at work on a Memoir on Peculiar Spectra, which will give useful tables and much additional information concerning many interesting celestial objects. Much of her time was always occupied by tedious work upon the proof of the numerous volumes of the Annals

published by the Observatory during the last twenty-five years. Her diligence and patience were combined with great self-reliance and courage. She was a member of the Astronomical and Astrophysical Society of America, and of the Astronomical Society of France. The British Royal Astronomical Society made her an honorary member in 1906, and soon after, she was appointed Honorary Fellow in Astronomy of Wellesley College. Only a few months ago, the Astronomical Society of Mexico presented her with a gold medal for her discovery of new stars.

She left one son, Edward P. Fleming, who graduated from the Massachusetts Institute of Technology in 1901, and is now a mining engineer in Chile.

Of a large-hearted, sympathetic nature, and keenly interested in all that pertains to life, she won friends easily, while her love of her home and unusual skill in needlework, prove that a life spent in the routine of science need not destroy the attractive human element of a woman's nature.

Annie J. Cannon
Harvard College Observatory,
Cambridge, Mass.,
June 3, 1911

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

The program of the Pittsburgh meeting on June 27, 28 and 29, is as follows:

Tuesday. Meetings at the School of Applied Science, Carnegie Technical Schools.

At 9:45 A.M. Address of welcome by Director A. A. Hamerschlag and response by President A. N. Talbot.

"Teaching English in Technical Schools," Professor S. C. Earle, Tufts College.

"The Preparation of Written Papers in Engineering Schools," Professor F. N. Raymond, University of Kansas.

"The Use of Logarithmic Diagrams in Laboratory Work," Mr. H. A. Gehring, Department of New York State Engineer.

"Highway Engineering," Professor A. H. Blanchard, Brown University.

At 2:00 P.M. Report of Committee on Teaching Mathematics to Engineering Students, Professor E. V. Huntington, Harvard University.

"Balance of Courses in Chemical Engineering," Dean C. H. Benjamin, Purdue University.

"Chemical Education for the Industries," Professor J. H. James, Carnegie Technical Schools.

A visit to the Country Club, followed by a dinner tendered by Director Hamerschlag on behalf of the Carnegie Technical Schools. During the evening President A. N. Talbot delivered his presidential address on the subject, "The Engineering Teacher and his Preparation."

Wednesday. Meetings at the School of Applied Science, Carnegie Technical Schools.

At 9:30 A.M. Report of the Committee on Entrance Requirements, Professor J. J. Flather, University of Minnesota, chairman.

"All-year Session, Individual Instruction: Renewed Suggestions," Dean W. G. Raymond, University of Iowa.

"The Architecture of Engineering Schools," Professor J. M. White, University of Illinois.

"The Wentworth Institute," Director A. L. Williston, Wentworth Institute.

At 8:30 P.M. Executive session of the society and election of officers.

"The College Campus," illustrated lecture by Professor J. M. White, University of Illinois.

Thursday. Meetings at Thaw Hall, University of Pittsburgh.

At 9:15 A.M. Address of welcome by Chancellor S. B. McCormick and response by President A. N. Talbot.

"An Engineering Course for Underclassmen," Professors W. A. Hillebrand and S. B. Charters, Jr., Stanford University.

"Electrical Engineering Instruction," Professor E. B. Paine, University of Illinois.

"Teaching of Scientific Shop Management, with Use of Engineering School Shops as the Laboratory," Professors H. Wade Hibbard and H. S. Philbrick, University of Missouri.

"Technical Training from the Business Man's Standpoint," Mr. E. B. Raymond, vice-president of the Pittsburgh Plate Glass Co.

"Adapting Technical Graduates to the Industries," Messrs. C. F. Scott and C. R. Dooley, Westinghouse Electric and Manufacturing Co.

"Cooperative System of Engineering Education at the University of Pittsburgh," Dean F. L. Bishop, University of Pittsburgh.

At 8:30 P.M. Assemble in foyer of Carnegie Music Hall. The Pittsburgh alumni of engineering colleges were invited to meet the representatives of the faculties from their *alma maters*. A brief program was rendered upon the organ

in Music Hall, after which the members visited the Department of Fine Arts and the Museum of the Institute.

FRIDAY AND SATURDAY.

Members are invited to remain in Pittsburgh after the close of the convention to make further visits among the industries described in the handbook. Specific arrangements may be made for these visits at the secretary's office during the meeting. Special arrangements were made for the benefit of visitors in a number of cases, notably the Bureau of Mines, the Jones & Laughlin Steel Company, the Mesta Machine Company, the National Tube Company, the Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company. It is expected that engineers will be detailed to guide the visitors, and that, in some cases, special exhibits and tests will be provided.

INDIANAPOLIS MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE Indiana Section made special efforts toward an unusually successful meeting beginning June 27 and lasting throughout the remainder of the week. The program was arranged as follows:

The council will meet on the afternoon of Tuesday, June 27, and after a business meeting will be taken for an automobile ride to the Indianapolis Speedway.

On Wednesday, the general session will begin and three general addresses will be given. Professor Charles Baskerville, of the College of the City of New York, will give an address on "The Chemistry of Anesthetics." Professor Edward Kremers, of the University of Wisconsin, will follow with a paper on "The Quinhydrone Hypothesis of Plant Pigmentation." The third address, by Professor W. Lash Miller, of the University of Toronto, will be upon "The Chemical Philosophy of the High-school Text-books." These papers will be followed by a complimentary luncheon at the German House and after luncheon meetings of the agricultural and food, industrial, organic and physical and inorganic divisions and the biological section will be held. In the evening a complimentary smoker will be held in the gardens of the German House.

On Thursday morning there will be meetings of the agricultural and food, industrial, organic, pharmaceutical and physical and inorganic divisions, one of the special features being the meeting of the pharmaceutical division in the new science building of the Eli Lilly & Co., followed by a luncheon there to the pharmaceutical chemists. At the same time a complimentary luncheon will be given to the remaining chemists at the Indianapolis Brewing Co., followed by an inspection of their plant. In the afternoon all of the chemists will visit the plant of the Eli Lilly & Co. On Thursday evening there will be a public lecture by Mr. A. D. Little at the German House on the "Earning Power of Chemistry." This lecture is one of the features of the meeting and is intended to interest chemists, business men and the general public alike. Following the lecture there will be a concert in the gardens of the German House.

On Friday there will be an early visit to the Indianapolis Water Works followed by meetings of the fertilizer, industrial, physical and inorganic divisions and the sections of biological and of india rubber chemistry. At 12:30 these will be followed by a complimentary luncheon at the automobile factory of Nordyke & Marmon, followed by an inspection of their factory. Later in the afternoon visits will be made to the Encaustic Tile Co., to the Fairmount Glass Works and to E. C. Atkins & Co. In the evening the usual banquet of the summer meeting will be held.

On Saturday there will be visits to the Kingan & Co., Ltd., to the Polk Sanitary Milk Co. and to the Diamond Chain Co.; in the afternoon, to the Van Camp Packing Co.

A special endeavor is also being made to see that the ladies accompanying members have an enjoyable summer outing, including automobile rides, receptions, theater parties and luncheons.

Over one hundred and fifty papers have already been received for the divisional meetings.

CHARLES L. PARSONS,
Secretary

SCIENTIFIC NOTES AND NEWS

Among the honorary degrees conferred by Yale University are doctorates of laws on Dr. Josiah Royce, professor of philosophy at Harvard University, and Dr. George E. Vincent, president of the University of Minnesota; the doctorate of science on Professor W. H. Howell, professor of physiology in the Johns Hopkins University, and the doctorate of letters on Mr. John Muir, naturalist and author.

Dr. Edgar F. Smith, provost of the University of Pennsylvania, has been given the doctorate of laws by Rutgers College.

The doctorate of science has been conferred by Wesleyan University on Dr. F. G. Benedict, director of the Nutrition Laboratory of the Carnegie Institution and by Tufts College on Dr. A. P. Wills, professor of mathematical physics in Columbia University.

The University of Pennsylvania has conferred an honorary doctorate of veterinary medicine on Dr. Veranus A. Moore, of the State Veterinary Department of Cornell University.

Brown University has given a doctorate of science to Dr. H. J. Wheeler, director of the Experiment Station of the Rhode Island College, and the master of arts to Mr. F. E. Seagrave, astronomer, of Providence.

Professor Franklin W. Hooper, director of the Brooklyn Institute of Arts and Sciences, has received the doctorate of laws from Middlebury College.

The London Mathematical Society has awarded the De Morgan medal for 1911 to Professor H. Lamb, F.R.S., for his work in mathematical physics.

Mr. Leonhard Stejneger has been appointed head curator of the department of biology in the U. S. National Museum to succeed Dr. F. W. True.

The board of scientific directors of the Rockefeller Institute for Medical Research announce the following appointments to the staff of the institute:

Alfred E. Cohn, M.D., associate in medicine.

Arthur N. M. Ellis, M.B., assistant resident physician.

Alphonse R. Dochez, M.D., assistant resident physician.

Frank W. Bancroft, Ph.D., associate in experimental biology.

Reinhard H. Beutner, Ing.D., assistant in experimental biology.

James B. Murphy, M.D., assistant in pathology.

J. J. Bronfenbrenner, fellow in pathology.

Frederick B. La Forge, Ph.D., assistant in chemistry.

Henry K. Marks, M.D., assistant in pathology.

Helen L. Fales, research scholar in chemistry.

Angelia M. Courtney, assistant in chemistry.

Professor F. W. Sardeson, of the department of geology of the University of Minnesota, has been appointed geologist on the U. S. Geological Survey. He has been directed to complete the areal, stratigraphic, and glacial geology of Minneapolis, St. Paul, Anoka and White Bear quadrangles and to prepare a folio descriptive of this region for publication.

Professor Herbert E. Gregory, of Yale University, has gone to Arizona in the interests of the United States Geological Survey in order to continue his study of the water supply and economic resources of the Navajo Reservation. He will be assisted in this work by Professor W. R. Barrows, Mr. K. C. Heald, of Colorado College, and Mr. H. F. Robinson, irrigation engineer of the Indian Service.

The International Seismological Association will hold its regular meeting in Manchester, England, from July 18 to 22. The United States is a member of this association, and will be represented at the meeting by Professor Harry Fielding Reid, of the Johns Hopkins University.

Dr. L. Murbach, head of the department of biology in the high school of Detroit, Mich., has been given a year's leave of absence. His address will be Castleton, Vermont.

Dr. John Milne, F.R.S., has been appointed Halley lecturer at Oxford for the year 1912.

On June 13, Professor Ernst Cohen, of the University of Utrecht, gave an illustrated lecture before the Faraday Society on "Allotropic Forms of Metals." Professor T. W.

Richards, of Harvard University, was invited to take the chair.

DR. I. W. BLACKBURN, professor of pathology in the Georgetown Medical School, and of morbid anatomy in the George Washington University, and for twenty-seven years pathologist in the Government Hospital for the Insane, died on June 19, aged 60 years.

THE United States Civil Service Commission announces that the Philippine government desires to fill two vacancies in the position of chemist, division of organic chemistry, Bureau of Science, Manila, P. I., at salaries of $2,000 each per annum. It is desired to secure the services of two young men between twenty and forty years of age with a high grade of scientific training who are capable of original work. A thorough training in general and organic chemistry at a reputable college or university and experience in organic research is a prerequisite for consideration for this position; a Ph.D. degree from a leading university would be preferable. A certain share of the routine work for the government would devolve upon the persons appointed to these positions, but the history of the laboratory in the past has shown that each man has had ample time for himself to do research work. In general, the men would select their own topics for investigation, such topics, of course, to have some bearing upon the development of the Philippine Islands. Facilities for immediate publication of research work are found in the *Philippine Journal of Science*, which represents the Bureau of Science before the world. The attention of persons well trained and experienced in organic chemistry is especially invited to these vacancies since, if persons of the desired qualifications are secured, the prospects of promotion for both will be good, as one will probably succeed to the position of chief of the division of organic chemistry at $3,000 per annum within a year or two. As applications for this position will not be received after August 1, 1911, those interested should communicate with the U. S. Civil Service Commission at Washington, D. C., before this date.

IT is announced by Dr. Edgar L. Hewitt, director of American archeology for the Archeological Institute of America, that the valuable library of the late German linguist, Professor Franz Nikolaus Finck, is to be brought to this country. It has been purchased by the Hon. Frank Springer, of New Mexico, for the use of the School of American Archeology, the research school of the Archeological Institute of America. The library is to be installed in the historic palace at Santa Fe, where the Museum of New Mexico and the School of American Archeology are now housed.

AT the Field Museum of Natural History, several new groups of American mammals have been placed on exhibition. The pronghorned antelope is shown by five animals in a setting of agaves, cacti and other vegetation of the arid southwest with a large painted background showing other natural features. Four groups of small mammals include the white-footed mouse, jumping mouse, meadow mouse and short-tailed shrew. These are grouped, respectively, on the four sides of a reproduction of a bit of woodland with logs, bushes, grass and flowers so arranged as to form an effective and characteristic background for each.

THE Sproul Observatory was dedicated at Swarthmore College on June 6. It has been presented by Senator William C. Sproul, as a memorial of the twentieth anniversary of the class of '91, of which he is a member. The exercises consisted of the address of presentation, in behalf of the class, by Congressman A. Mitchell Palmer, '91; the unveiling of the tablet by Miss Dorothy Sproul, daughter of the donor; the speech of acceptance, by Dr. John A. Miller, professor of mathematics and astronomy; an address by Miss Susan J. Cunningham, formerly in charge of the same department, and a poem, "Watching the Stars," written for the occasion, by J. Russell Hayes. The new observatory is expected to be ready for use next fall. The telescope, the lens of which will have a diameter of 24 inches, will be one of the most effective on the Atlantic coast.

An expedition to southeast Arabia has been planned by the Danish Royal Geographical Society, the object being the mapping of parts of Oman and the studying of the ancient memorials and commercial prospects of the country.

A cablegram has been received at the Harvard College Observatory from Kiel, stating that Wolf's Periodic Comet was observed by Professor Max Wolf at Heidelberg, June 19, 1911, 4792 in.

R. A. $18^h\ 46^m\ 16^s$
Dec. $+13°\ 28'$

The comet is visible in a large telescope.

The second annual midsummer State Farmers Institute will be held at the University of Illinois on Tuesday, Wednesday and Thursday, July 11, 12 and 13. The attendance at last summer's institute was about 2,500. Addresses to the general session will be given by the following:

Hon. J. K. Dickinson, secretary, State Board of Agriculture, on "Agricultural Advancement."

Professor J. H. Skinner, dean of the College of Agriculture, Purdue University, on "Rural Problems and Rural Progress."

Hon. B. F. Harris, president of the Illinois Bankers' Association, on "The Banker Farmer, his Influence on Agriculture."

Dr. Charles E. Marshall, Michigan Agricultural College, on "The Farmer and the Scientist."

Hon. W. E. Morse, assistant general manager, Chicago Northwestern R. R., on "Advantages of Closer Cooperation between the Railroads and the Farmer."

The following geologic investigation is being carried on in Oklahoma: Professor D. W. Ohern, of the University of Oklahoma, and Mr. Carl D. Smith, of the U. S. Geological Survey, are conducting cooperative parties in the Vinita and Claremore quadrangles in the northeastern part of the state. Professor C. H. Taylor, of the University of Oklahoma, is studying the igneous rocks of the Wichita and Arbuckle Mountains. Professor J. W. Beede, of the University of Indiana, has a party in the northern part of the state and will endeavor to trace out the Pennsylvanian-Permian contact from the Kansas line to the Arbuckle Mountains. Professor C. A. Reeds, of Bryn Mawr College, who has already spent four years in the Arbuckle Mountains, will continue his studies in the lower Paleozoic rocks of that region. The Ohern, Smith and Taylor parties are cooperative; being maintained by the U. S. Geological Survey and the Oklahoma Geological Survey; the Beede and Reeds parties are under the direction of the Oklahoma Geological Survey. The U. S. Geological Survey, the Oklahoma Geological Survey and the Oklahoma State Board of Agriculture are cooperating in the endeavor to ascertain whether or not potash or other soluble salts are present in the western part of the state. A number of deep wells are being drilled, under the direction of the state board of agriculture, in the Panhandle of Oklahoma, in the hope of finding artesian water. The federal Geological Survey and the Oklahoma Survey are paying the expenses of a man to collect samples at frequent intervals from these wells. These samples will be analyzed for potash or other fertilizer material. Mr. Chas. R. Eckes has charge of the work.

UNIVERSITY AND EDUCATIONAL NEWS

Princeton University has received gifts amounting to more than $100,000, of which $40,000 is for a lectureship in public affairs to be held by the Hon. George B. McClellen.

Dr. Robert A. Harper, professor of botany in the University of Wisconsin, has been elected Torrey professor of botany at Columbia University.

New appointments and promotions at the Johns Hopkins University are as follows: In the Philosophical Faculty: Harry F. Reid, Ph.D., now professor of geological physics, to be professor of dynamic geology and geography; John A. Anderson, Ph.D., now associate, to be associate professor of astronomy; Knight Dunlap, Ph.D., now associate, to be associate professor of psychology; J. Elliott Gilpin, Ph.D., now associate, to be associate professor of chemistry; William Kurrelmeyer, Ph.D., now associate, to be associate

professor of German; B. Franklin Lovelace, Ph.D., now of the University of Alabama, to be associate professor of chemistry; Samuel O. Mast, Ph.D., now of Goucher College, to be associate professor of zoology; August H. Pfund, Ph.D., now associate, to be associate professor of physics; Charles F. Meyer, A.B., now fellow, to be assistant in applied electricity; Chester N. Myers, Ph.D., to be assistant in chemistry. In the Medical Faculty: Thomas R. Boggs, M.D., now associate, to be associate professor of medicine; Charles D. Snyder, Ph.D., now associate, to be associate professor of physiology; Frank J. Sladen, M.D., now instructor, to be associate in medicine; William E. Burge, Ph.D., now assistant, to be instructor in physiology; Karl M. Wilson, M.D., now assistant, to be instructor in obstetrics; Solon A. Dodds, M.D., to be assistant in obstetrics; Eli K. Marshall, Jr., Ph.D., to be assistant in physiological chemistry; Isaac R. Pels, M.D., to be assistant in dermatology; Maxwell Ross, M.D., to be assistant in medicine.

FACULTY additions and promotions in Adelbert College and the College for Women of Western Reserve University have been made as follows: Harry William Springsteen, assistant professor of physics, to be associate professor of physics; Clinton Raymond Stauffer, Ph.D., associate professor of geology; James K. Whittemore, M.A., appointed assistant professor of mathematics; Walter Edward Sullivan, M.A., instructor in biology. Faculty promotions and appointments in the medical department were made as follows: George Washington Crile, Ph.D., M.D., formerly professor of clinical surgery, was appointed professor of surgery; Carl August Hamann, M.D., formerly professor of anatomy, was appointed professor of applied anatomy and clinical surgery; Davidson Black, M.B., was appointed associate in histology and embryology.

IN the University of Michigan Museum, Dr. A. G. Ruthven has been promoted to be assistant professor of zoology and head curator of the museum; Miss Crystal Thompson has been made assistant in the museum. In the Department of Zoology, Dr. A. F. Shull, of Columbia University, has been made instructor in zoology, in place of Assistant Professor A. S. Pearse, who has become assistant professor of zoology in the University of the Philippines; Dr. George La Rue, of the University of Illinois, has been made instructor in zoology. Assistant Professor O. C. Glaser has been granted leave of absence during the first half of the next academic year.

AT Rutgers College instructors have been appointed as follows: F. F. Couch, M.E. (Lehigh), in mechanical engineering; Floyd E. Chidester, Ph.D. (Clark), in biology, and Harry R. Lewis, B.Sc. (Rhode Island), in dairy husbandry.

FRANK A. MANNY, of the education and extension departments of the Western State Normal School, Kalamazoo, Mich., has been appointed director of the training of teachers in the city of Baltimore.

THE trustees of the University of Pennsylvania at a meeting held on June 12, 1911, advanced Dr. John W. Harshberger from assistant professor of botany to professor of botany.

DISCUSSION AND CORRESPONDENCE

THE DISEASES OF ECONOMIC PLANTS

THE recent review of "Diseases of Economic Plants" by Dr. W. A. Orton[1] contained statements which I feel impelled to controvert, not in justification of the book, but in order to place the facts in their proper bearing before the readers of SCIENCE, lest some not technically informed should be led into erroneous conclusions by misstatements *ex cathedra*.

Some of his criticisms are merely matters of personal opinion, as, for example, his views on the use of the termination "ose" in naming diseases. This method was first suggested several years ago in a committee report before the American Association for the Advancement of Science, Section G, with Dr. Halsted as chairman. It has been used to

[1] SCIENCE, April 21, 1911, 621.

some extent in this and other countries for years, and while some pathologists do not favor it, many others do. Moreover, Dr. Orton himself, in a letter,[2] writing on this point, says, "I would even make use of the new terminology in cases where no other suitable common name is available."

His mention of "more serious errors" deserves attention. Here he objects to considering *Microsphæra alni* as a destructive parasite, saying, "This fungus is one of the least harmful of the pecan parasites." Fawcette[3] quotes Mr. W. A. Munsell, of Florida, as saying that this fungus "had practically destroyed the pecan crop the year before."

Orton says, "The injury to tomatoes from *Phytophthora* is overstated." We stated that "It is very injurious, causing complete devastation of the crop in some sections and resulting in the loss of many thousands of dollars."

Authority for this may be found in the statement of R. E. Smith,[4] a very careful and reliable worker, who says, "During the fall of 1907 the whole acreage of tomatoes was completely ruined in this manner (by *P. infestans*) before active shipment had begun, making the crop a total loss." Also "in the district mentioned the shipments fell off within a very short time, from 2,000 crates a day to practically nothing . . . many thousands of dollars were lost."[5]

Orton himself[6] says of this disease, "Quite common in Massachusetts . . . reported also in southern California, where it caused large losses to the winter crop."

Orton says, "Absurdly large losses are attributed to cotton anthracnose in Georgia."

Our words are:

> The disease is very destructive in some localities and prevails throughout a large portion of the cotton belt. In central Georgia it is said to destroy about 22 per cent. of the crop yearly, sometimes more; while to the state as a whole the loss is put at 17 per cent. or approximately $14,750,000.

I may here quote the following:[7]

> From middle to north Georgia the gradual decrease in per cent. of the crop destroyed is from 22 per cent. to about 12 per cent. and to south Georgia, from 22 per cent. to about 4 per cent. It is conservatively estimated that the anthracnose costs the farmers of the state at least 17 per cent. of the cotton crop. 1,800,000 bales are gathered in Georgia, which represents then, only 83 per cent. of the crop that should be made, the other 368,900 bales representing the actual loss. This valued at $40 a bale would be $14,756,000 loss in money.

De Loach, the author of this statement, in a recent letter says:

> My statistics carefully taken in sixteen counties of the state of Georgia, in 1906 and 1907, and amounting at the least to 2,000 bolls in a locality, prove clearly to me that for those years my figures were quite conservative. I always selected representative localities and fields, and was making the survey for no other purpose but to estimate the actual loss to the growers incurred by this disease. In several instances in Spalding and Hart counties there was 80 per cent. of the bolls infected, but of course not this per cent. actual loss, as many of the bolls were half good and half diseased.

Orton says: "The description of Bordeaux injury is incorrect, as is also the statement that blossoms are killed and the lives of bees endangered."

As to Bordeaux killing bees it must be recollected that apple spraying is the topic under discussion; that the only time bees would be injured is while the tree is in blossom; that when the tree is in blossom arsenicals are almost invariably used in the spray, hence to spray during blossom is, in practise, dangerous to bees.

The description of Bordeaux injury given in the book is drawn largely from the writings of Hedrick,[8] who wrote his description follow-

[2] February 14, 1910.

[3] Fawcette, H. S., Fla. Agr. Expt. Sta. Rept., 1907, LI.

[4] Report Cal. Agr. Expt. Sta., Bull. 203, p. 44.

[5] R. E. Smith, Cal., B. 175, p. 9.

[6] Yearbook, 1905, p. 608.

[7] Ga. Agr. Exp. Sta., Bull. 85, Tech. Ser., 3.

[8] Geneva Bull., 287, pp. 107–108, Nos. 7, 10 and 11.

ing long experience with Bordeaux injury, a personal experience that is certainly far more extensive than that of Dr. Orton. I quote here a recent letter from Hedrick bearing on this point.

I have just gone over the description you give of bordeaux injury in your "Diseases of Economic Plants" and in my bulletin on the subject. I can find nothing whatever to criticize in the statement you make in regard to this trouble. I may say that since my bulletin was published, I have had occasion to give a good deal of attention to Bordeaux injury and do not believe that I would now describe it differently than when the bulletin was written. My colleague, Professor Stewart, whom of course you know, and who has also given Bordeaux injury a good deal of attention, has just looked over your description and finds nothing to criticize in your discussion of the injury in question.

It is gratifying to know that in these "more serious errors" the text of the book does not deviate widely from a basis, founded on exceedingly good authority, authority in some instances, most instances in fact, as trustworthy as that of our critic.

Dr. Orton was requested to read and criticise the manuscript of our book prior to its publication. This he, with apparent willingness, agreed to do. The manuscript of a large portion of the book, including most of the part under discussion, was submitted to him and certain criticisms were received, some of which were accepted, some not, according to the judgment of the authors. For all of this the authors are grateful to Dr. Orton.

That Dr. Orton is much more aggressive and much more searching in this recent public criticism, *after publication, than in his private criticisms prior to publication* may, however, be shown by two quotations as well as by many other adduceable facts.

From letter February 16, 1910, "you already have a discussion of the most important non-parasitic diseases."

From review in SCIENCE, April 21, 1911, "The wilt and die back of the orange are omitted, as is the curly top of beet, one of the two most important maladies of that crop."

F. L. STEVENS

SCIENTIFIC BOOKS

The Stone Age in North America. By WARREN K. MOOREHEAD, A.M. Two volumes of 874 pp., 7 in. by 9¾ in., 17 plates, 4 of which are colored, and 735 figures in the text. Boston and New York, Houghton Mifflin Co. 1910.

This is the most ambitious work yet produced on the prehistoric implements of the United States. The book deals almost wholly with this area, although Ontario and a few other sections of the Dominion of Canada are briefly covered. Mexico and Central America with their highly developed stone age culture are omitted.

The opening chapters deal with the classification of stone implements according to form and material; with quarry sites and methods of quarrying; the making of projectile points and knives; the cached deposits of finished and incomplete implements; and the general distribution of types. Stone chipping in America had reached a high degree of excellence, and some of the finer examples from California, Tennessee and Ohio are probably not surpassed in workmanship by those of any section of the world.

The author next describes what he calls the celt-hatchet-axe-adze class of implements which includes adze blades of various types and the grooved and grooveless axe. They are shown in great variety. The remainder of the first volume is devoted to problematical forms. Under this general head are figured and described flat stone pendants, perforated tablets, winged ceremonials, "spud"-shaped objects of slate, pear-shaped pendants, discoidal stones, circular discs for paint, stone tubes, and other types. Nearly nine hundred of these objects are illustrated from photographs furnished principally by collectors.

The second volume opens with a chapter on bird stones and other effigies. This is followed by a treatise on the tobacco pipe. Beginning with the early tubular type a large variety is shown ranging through the simple curved and angular forms to the platform and effigy pipes.

The next chapters are devoted to mortars, pestles, metates, mullers, stone dishes used in preparation of foods and paint, and to shell and bone ornaments, utensils, implements and weapons in considerable variety. The bone objects from the Mandan village sites are of special interest as are also the cut and inlaid bear teeth and engraved bones from the Ohio mounds.

The native copper implements of the Great Lakes region are well illustrated. The elaborate ceremonial forms from the mounds of Ohio and other sections are of great interest. Implements of this metal are principally knives and projectile points, perforated needles, fish hooks, adzes and axes. The ornaments are mainly beads, breast plates and ear buttons. Some of the symbolic forms are elaborate, especially those shown in repoussé designs. Various tribes in the United States had mastered the early stages of copper working, but they had not discovered the art of casting. All the forms shown were made by hammering, annealing, grinding, perforating, cutting or embossing. Sheet mica was also cut into symbolic and ornamental designs similar to those of copper.

A few textiles from the dry caves of Kentucky and the Ozark region and from the cliff-house ruins of Utah are described and illustrated. The twined woven shoes from the Kentucky caves are unique. The specimens shown in general however give but a faint idea of the great variety and beauty of the woven fabrics common among our Indians in early historic times.

The pottery of the United States is treated briefly, types from the various culture areas being shown. Many of the illustrations are from the publications of W. H. Holmes and C. B. Moore. The author writes, "In the far north there is no pottery." He forgets the well-made pottery bowls, lamps and cooking pots of the Alaskan Eskimo.

The following chapters are devoted to grooved axes, celts, pendants and other forms in hematite, and also to miscellaneous objects of stone, such as salmon clubs from Oregon and Washington, perforated stone club heads, grooved stones for straightening and finishing arrow shafts, semi-lunar knives of slate, etc.

The last two chapters are devoted to the author's conclusions which are grouped under several headings. He acknowledges his indebtedness to forty individuals who contributed plates, figures, or to the text, or who allowed the use of published material. The most important of these original contributions is the excellent bibliography of forty-one pages by Dr. Charles Peabody.

The "Stone Age in North America" is written primarily for collectors and the general public, but anthropologists will find much of interest in its pages.

The author's view point of American archeology is best shown by the following quotation from the opening chapter.

> It seems to me that the study of all these learned individuals, the results of which are set forth in the Indian "Handbook" [Bureau of American Ethnology], has led many of them to consider prehistoric life in America as nearly the same as the life of our Indians for the past one or two centuries. I can not believe that the arts of the past are the same to any appreciable extent as those which obtained at the time of the Lewis and Clark expedition.

Again in the closing chapter, referring to certain New Jersey archeologists, he writes:

> They understand conditions as they existed in ancient times, and that is something that few men of to-day grasp. It can not be learned from reading the reports, from studying in museums, or through obtaining a degree from one of our universities.

The failure to comprehend the culture of the prehistoric American Indians except through the study of their stone implements and similar remains is a defect common to many archeologists which is usually apparent in their writings. We can never acquire a comprehensive knowledge of ancient American peoples without first studying existing tribes, and working backward through history, for stone implements alone can teach little without the knowledge thus acquired.

Charles C. Willoughby

A Concise History of Chemistry. By T. P. HILDITCH. Pp. 263, 12mo. New York, D. Van Nostrand Co. 1911.

This little treatise is an attempt to lay before students of chemistry a condensed summary of chemical history. In many respects it is likely to be a useful book, although its conciseness is often an obstacle to intelligibility. Its use demands a rather wider range of knowledge than the average student is likely to possess. The chapter upon the earlier history of chemistry, and the evolution of the science, covers familiar ground, but with much omission of detail; the chapters dealing with more specific subjects are very unequal in value. The author is an organic chemist, and therefore the chapter upon organic chemistry is remarkably full and well handled. It includes a number of tabular statements illustrating classes of compounds, which will doubtless be found valuable for reference. The chapter on inorganic chemistry is much less satisfactory, and hardly up to date. Apart from a brief reference to the use of the rare earths in incandescent lighting, there is little or nothing relative to the modern utilization of the less common metals, and the paragraph dealing with synthetic mineralogy is even misleading. Physical chemistry receives rather better treatment, but even here the phase rule is given inadequate space and in the index it is credited to Wolcott Gibbs. This error, which may be due to the indexer rather than to the author, is one of several indications that Mr. Hilditch is unfamiliar with American work. For example, Classen is credited with the introduction of electrolytic methods of chemical analysis, an advance which was really initiated by Wolcott Gibbs, and to which Edgar F. Smith has been a chief contributor. So also, although Richards is barely mentioned on page 202, his name is omitted from the tabular statement of atomic weight methods which follows. In spite of these defects the volume may be serviceable to advanced students.

F. W. CLARKE

An Introduction to the Chemistry of Paints. By J. NEWTON FRIEND, Ph.D., D.Sc. New York, Longmans, Green & Co. Pp. 204, 8vo.

This book is designed to present this subject to those who have had no training in physics or chemistry, and may be regarded as an unqualified success. It makes no claim to be encyclopædic, and yet one finds terms and descriptions not given in much larger works.

One or two errors have crept in, such for example as the saponification numbers (p. 126) being given as 19.3, etc., when they are ten times as large: another is the position of the thermometer bulb in Fig. 16 which is much too low.

It is an excellent book and may be cordially recommended to all desiring information in this branch of technology.

A. H. GILL

THE WORK OF THE MARINE BIOLOGICAL STATION OF THE U. S. BUREAU OF FISHERIES, AT BEAUFORT, N. C., DURING THE YEAR 1910

A NUMBER of the investigations of the preceding year were continued and several new lines of work were begun. The equipment of the laboratory was maintained and a number of additions were made to the same. A launch, operated by two gasoline engines, was substituted for the steam-launch formerly used. The new launch is of small draft, which feature enables it to be used for dredging and for other operations in the vicinity of Beaufort. In addition to this vessel, the station has been equipped with a motor-boat, a sailboat and twelve rowboats.

During July and August the laboratory was supplied as usual with electric lights. During the same period a mess was conducted at the station for the use of the scientific staff. The cost of table board for each member was five dollars per week, the same as during the preceding year. The laboratory was supplied with running fresh and salt water throughout the year. The small storage ca-

pacity of the salt-water tank has for several years made it necessary to pump water from the harbor at times when it was unsuited for experimental work. It is possible that a tank of 10,000 gallons capacity will be erected.

The library was increased by the addition of a number of publications and by the receipt of reprints, the latter in many cases contributed by the authors.

The work on the molluscan fauna, noted in the report for last year,[1] was continued. The laboratory now has a nearly complete collection of the lamellibranchs of Beaufort correctly identified and labeled for study and reference. The collection includes a number of species collected some distance off-shore by the Fisheries Steamer *Fish Hawk*. The identifications were either made or verified by Dr. Wm. H. Dall, of the National Museum. Some progress on the gastropods of the region was made along similar lines.

The experimental work on the culture of the diamond-back terrapin was continued and considerable success was attained. About 270 young terrapins were hatched during the season, and at the close of the year the whole stock was in a thriving condition. A portion of the terrapins hatched during 1909 showed excellent growth during 1910. Preparations were begun to enlarge the scope of the work, which will include the construction of two additional concrete pounds. These pounds will be of permanent service to the laboratory for numerous lines of scientific work, in case they can be spared for other than the original purposes. As these pounds are supplied with fresh sea water at each high tide they would make excellent vivariums for keeping marine animals under nearly natural conditions, and they would at the same time be subject to control. The terrapin work has been under the general direction of Professor W. P. Hay, of Washington, D. C.

In cooperation with the U. S. Weather Bureau a daily record of the maximum and minimum temperatures and of the rain-fall, as well as of other miscellaneous meteorological phenomena, has been kept. This work has been carried on without interruption since the summer of 1905. Some attention was given to the cultivation of the oyster in Pamlico and Core Sounds. An inquiry was also made in regard to the character of fossil remains excavated during the process of construction of the new canal connecting Beaufort Harbor with the Neuse River.

The facilities of the laboratory were utilized by a number of investigators, either for independent research or for the scientific work of the bureau. They have kindly furnished abstracts of their work, which are included herewith.

Professor H. V. Wilson, of the University of North Carolina, carried on an investigation for the bureau dealing especially with the regenerative power of the tissues in hydroids. Professor Wilson had shown that when the tissues of certain sponges are forcibly broken up into their constituent cells, the cells will re-unite and form plasmodial masses which differentiate into perfect sponges. It seemed desirable to learn whether this power was possessed by the tissues of other aquatic forms. The investigation showed that hydroid tissues have this power.

Experiments were conducted on two hydroids, *Pennaria tiarella* McCrady and *Eudrendrium carneum* Clarke. The phenomena were essentially the same in the two forms. The cells and small cell masses into which the hydroid flesh is broken up reunite and form masses, the size of which is in a measure under control. These secrete a perisarc. As compared with the corresponding masses in certain sponges they are subject to great mortality. Some survive and after a few days give rise to hydranths with the characteristics of the species.

The inquiry was extended to learn what power of fusion lies in the forcibly separated cells of the alcyonarian, *Leptogorgia,* and in those of the immature gonad in *Asterias.* In each case active fusion goes on between the cells and cell lumps into which the flesh has been broken up, and masses are obtained which acquire a smooth surface. These were

[1] Science, May 6, 1910.

kept alive in laboratory dishes for some days, but underwent no further change.

Dr. E. P. Lyon and Mr. L. F. Shackell, of St. Louis University, worked upon problems connected with the fertilization of the ovum, directing their attention particularly to the chemical differences between fertilized and unfertilized eggs, using for the most part sea-urchin material.

A large amount of material for chemical analysis was collected which is to be worked up in the Physiological Laboratory of St. Louis University; also at Chicago through the cooperation of Professor Waldemar Koch, of the University of Chicago.

Messrs. Lyon and Shackell studied the changes in permeability occurring in eggs resulting from fertilization, and a preliminary article on this work was published in SCIENCE, August 19, 1910.

Dr. E. W. Gudger, professor of biology and geology, State Normal College, Greensboro, N. C., spent ten weeks at the laboratory beginning May 25.

Owing to the difficulty in getting eggs and embryos in May and early June, he was unable to complete his series for the life history of the gaff-topsail catfish. He now lacks only the segmentation and the earliest invagination stages. He was very successful, however, in hatching the eggs and rearing larvæ.

He was also successful in getting about half the stages for the life history of the butterfly ray, and hopes to complete this series next season. Some of these larvæ are very extraordinary in form.

In his work with the spotted sting ray, he was fortunate in obtaining three perfect specimens, two of them alive. From these it is hoped that certain variations in color, spots and teeth may be explained.

Careful photographic records were made of all the material referred to above, and an artist (Mr. E. A. Morrison, Jr., of Baltimore), under a grant from the Carnegie Institution, spent two weeks making drawings, chiefly of early stages of the gaff-topsail catfish.

Dr. H. S. Davis, of the University of Florida, worked at the laboratory during portions of July and August. The time was spent in examining fishes for parasitic protozoa and in observations on the morphology and life history of the parasites found, the work being largely of a preliminary nature to serve as a basis for further more detailed investigations.

A total of 26 species of fishes were examined for protozoan parasites. In the case of several of the more common species many individuals were examined, but with the rarer species the investigation was often necessarily limited to the examination of one or two specimens. Most of the parasites found were Myxosporidia, and of the 26 species of fish examined 14 were found to be infected with these parasites. As is usually the case, the gall-bladder was found to be most commonly infected, 13 out of the 14 species showing infection of this organ. In 2 species both the gall- and urinary-bladders were infected, but, of course, by different species of Myxosporidia. In a few cases the gall-bladder was found to be simultaneously infected with 2 species of Myxosporidia. In most cases the percentage of infected individuals was high, sometimes reaching 100 per cent. This was found to be especially true of the adults which were much more commonly infected than the young of the same species. It is significant that, in the case of those species in which Myxosporidia were not found, usually only one or two individuals were available for examination and these were often immature.

In the case of all the species of fish found to be infected no myxosporidian parasites have previously been recorded.

The Myxosporidia found belong to 6 genera, as follows, the species in many cases being apparently undescribed: *Sphærospora, Sphæromyxa, Chloromyxum, Ceratomyxa, Myxobolus* and *Henneguya*. In several cases, on account of the absence of material in the proper stages, it was found impossible to determine the genus.

In at least two cases the same species of Myxosporidia was found to occur in two or more species of fish.

A large amount of material was preserved with a view of working out the life history of several species as far as possible, and is being worked up as rapidly as time will permit.

The fresh blood of a large number of individuals was carefully examined for trypanosomes or Hemosporidia, but with uniformly negative results.

Dr. James J. Wolfe, professor of biology, Trinity College, Durham, N. C., spent the months of July and August at the laboratory. Dr. Wolfe collected material and began studies with a view to publishing a complete life history of *Padina*. The microscopic technique was worked out and a beginning made on the cytological side of the problem. In addition sixty-six cultures consisting of germinating tetraspores, fertilized and unfertilized eggs, were started in the laboratory on oyster shells and later transferred to the harbor for the purpose of testing by cultural methods the theory of alternation of generation and also the vitality of eggs which germinate parthenogenetically. The cultures which survived were collected and forwarded to Dr. Wolfe for examination later in the season. Contrary to published notices, female plants were found here in abundance. These bear a close resemblance to tetrasporic individuals—a fact which probably accounts for their having been overlooked. Contrary also to published notices, it was found rather late in the season that there is a regular succession or periodicity in the production of the sexual elements.

Dr. H. S. Colton, of the University of Pennsylvania, worked at the laboratory during the spring. During the previous winter at the University of Pennsylvania, Dr. Colton had been working on the morphology and physiology of the pyloric gland of the ascidian, *Botryllus*. This organ is composed of branching tubules with blind endings. These tubules ramify over the walls of the intestine, opening by means of a single duct into the stomach. This gland he has found to have the characters of an excretory organ in *Botryllus*.

While at Beaufort last spring, he was able to extend these observations on to other forms of Tunicates—*Amaroucium, Perophora, Ascidia, Styela* and *Molgula*. The result of these observations helped confirm the conclusion arrived at by the study of the organ in *Botryllus*.

Dr. J. M. Wilson, of Washington, D. C., made collections and preparations of selachian brains for the purpose of comparison with the teleostean brain, especially that of *Ameiurus*.

Mr. W. H. Kibler, of Guilford College, collected material for the study of the origin of the sex cells of fishes. Consecutive stages in the development of the toadfish were obtained, together with certain stages from the blenny and *Fundulus*.

Mr. L. F. Shackell, instructor in physiology, St. Louis University School of Medicine (in addition to his collaborative work with Dr. Lyon), collected considerable material for a study of the nutritive value of the edible crab, *Callinectes sapidus*. A study is also being made on the chemical changes taking place in *Callinectes* during the moulting period. Most of the analyses are being made in St. Louis.

Mr. Peter Okkelberg, of the University of Michigan, studied principally fishes and fish parasites. Most fishes were found to be infested with parasites and collections were made for future study.

A general study was also made of the local fauna. Note was taken of the distribution and habits of the different forms, with special reference to their adaptation to environment. Ample opportunity was furnished for the study of live animals under control. The structure and development of many forms were also studied.

Protozoans, jellyfish and larvæ of different kinds were obtained by towing, and a study was made of the material brought up by the dredge in various parts of the harbor. The extensive shoals and beaches were frequently surveyed and all the material found was studied as far as time permitted.

Mr. Raymond Binford, Johns Hopkins University, continued the study of the life histories of the crabs of Beaufort, especially that of *Menippe mercenaria*. By a later study of the material killed and preserved during the summer, the processes of fertilization and gastrulation in this crab are being worked out.

In experiments in which eggs were subjected to differences of temperature, those which were kept a few degrees above normal hatched nine days after they were fertilized, while those kept below the normal hatched on the thirteenth day after fertilization.

Some twelve hundred of these crabs were caught in the waters about the Beaufort harbor during the summer.

Mr. J. D. Ives, instructor in biology, Wake Forest College, made observations on the regeneration of nemerteans and *Amphitrite* during the month of August. Sections of nemerteans were found to regenerate readily. The anterior surfaces of the sections were found to regenerate but a small amount of new material compared with that formed by the posterior surfaces. The posterior surfaces of the sections regenerated rapidly. In about four weeks, sections of worms not over one half inch long were found to more than double their length with new material.

The tentacles of *Amphitrite* when pulled off were found to regenerate readily. In about ten days or two weeks after removal, the tentacles attained nearly an inch or about half of their normal length. When the entire tentacle bearing somite is cut off, the worm lives almost as well as when only the tentacles are removed. When the somites bearing both the tentacles and the first pair of branchiæ were cut off, some few specimens lived for over two weeks.

HENRY D. ALLER

THE BIOLOGICAL EFFECTS OF RADIUM[1]

AMONG the first discoveries made after the production of concentrated radium salts was that radium is capable of causing intense effects upon living tissues. We were not unprepared for such a discovery in the case of radium because similar phenomena had been observed early in the study of X-rays. In the case of X-rays the discovery had been totally, and very unfortunately, unexpected. The early burns from radium were of the same character as X-ray burns, and later detailed study has shown that the effects upon tissues of the two agents are practically identical. An appreciation of this fact is useful at the outset of a consideration of the biological effects of radium; it gives one at once a large number of analogous facts that have been well studied and, because of the more extensive study that has been made of the biological effects of X-rays, enables one to correlate more satisfactorily some of the isolated observations upon the actions of radium. Because the gross effects of radium, which furnish us many valuable facts, can be studed in the skin, and because the effects upon the various tissues of the skin give us the most comprehensive view of the biological effects in general of radium, it is conducive to clearness to consider first the effects of radium upon the skin, meaning by the skin in this connection the human skin or skin of similar structure of other animals.

When the human skin is exposed for a sufficient length of time to an active radium salt a peculiar and definite reaction is set up, of which the first striking feature is that it does not develop until after a relatively long period of quiescence—as a rule about two weeks. In a skin containing a considerable amount of pigment, there is first an increase of pigment, shown by an ordinary "tanning" of the exposed surfaces. If there are any freckles or pigmented spots in the exposed area, these become darker. Along with this pigment stimulation there occurs a reddening of the skin, with a feeling of irritation and burning such as one has from sunburn. The reaction may stop at this point and after a few days gradually subside; the redness and irritation diminish, there is some scaling from the surface and in a few days more no evidence of the reaction remains,

[1] Address before the Illinois State Academy of Science, Chicago, February 18, 1911.

except the increased pigmentation which is very slow to disappear.

In this reaction we have had simply the familiar picture of sunburn. But the process, in many cases, goes much further, and then there occurs a reaction which is peculiar to X-rays and radium. After the development of an inflamed, reddened area of skin the surface becomes intensely congested, purplish, and then blisters form. At the same time, or before, the hairs loosen and fall out. Next the blisters rupture and leave a surface covered by a necrotic pellicle, like a diphtheria membrane. And the reaction may go still further, with the formation of an ulcer whose striking characteristics are its painfulness and its extreme indolence, showing, it may be for months, no tendency to regeneration. The process may stop at any of the stages described above. If subsidence occurs short of ulceration the skin may again become normal, but after the severe reactions without ulceration, and after ulceration, when healing takes place there may be very distinct permanent changes in the skin. The hairs grow sparsely or not at all; the pores are very fine or absent, from destruction of the glands of the skin. The skin is thinned, with here and there roughened horny points or patches up to the size of a finger nail, and the surface is reddened from numerous dilated capillaries which show through the thinned horny epidermis.

We have here, as a result of these powerful forms of radiant energy, a picture of extreme interest. The condition is in fact an exact, sometimes an exaggerated, picture of the atrophic senile skin, with its dilated blood vessels and senile keratoses. As a matter of fact the picture is so nearly that of senile skin that I was able, in the case of X-ray lesions, to predict that cancers of the skin would be found to develop in them because the keratoses of old age are so frequently the starting point of cancers. It would take us too far from our subject to give all of the reasons for the idea, but the identity of chronic radium and X-ray changes in the skin with those of the senile skin, strongly indicate that the senile changes of the skin are in good part the result of the less powerful action over a long period of years of sunlight. Another fact, that is beside our topic, is highly interesting in this connection: Cancers develop in the keratoses of X-ray and radium dermatitis, and in them we have one form of carcinoma which is directly traceable to its exciting cause; and only by bringing in a *deus ex machina* in the form of later infection can one avoid the conclusions that at least in these lesions we have cancer which is not of microbic origin.

When radium is applied to various pathological lesions in the skin the same phenomena occur that are seen in healthy skin, with the addition that under proper precautions selective destructive effects may be produced upon the diseased tissues. Take, for illustration, nodules of tuberculosis or of carcinoma or sarcoma (cancers) in the skin. With proper care in grading the applications a reaction may be produced which will cause these tissues to be entirely destroyed, while this reaction is not sufficient to destroy the normal stroma in which they are situated, or, if it does destroy the normal tissues in the involved area, they will regenerate with the formation of healthy scars. It is also found in itching and painful conditions of the skin that the applications have a definite anesthetic effect.

The microscopic changes in tissues undergoing a radium reaction are even more interesting than the gross changes. In the early stages of radium irritation sections show evidences of proliferation of the tissue elements, such as indicate an over-stimulation of the cells by a peculiar irritant. These changes are most marked in the tissues of the greatest functional activity. At first there are an increased production of pigment, and an exaggerated proliferation of the germinal and younger (deeper) cells of the epidermis, especially of the cells of the follicles of the epidermis; in the corium or body of the skin, there are dilatation of the capillaries, an infiltration of round cells, and œdema—the changes of inflammation. Later the changes become exaggerated: there is proliferation of the inner layer of the blood vessels (an ob-

literating endarteritis); the round-cell infiltration becomes intense; the connective tissue fibers are œdematous and stain poorly. In the epidermis the cells show extreme degenerative changes; they become vacuolated, the nuclei are fragmented, there is degeneration of the cytoplasm so that stains are taken poorly, and complete breaking down of many cells. These changes are especially intense in the highly specialized and active cells of the appendages of the skin—the hair follicles and the sweat and sebaceous glands—and they may result in the obliteration of these structures, a phenomenon which, occurring as it may without destruction of the surrounding tissues, is not produced by any other known agent. In the last stage in a radium reaction there is necrosis of all of the affected tissues, the connective tissue stroma being the most resistant and last to break down. In diseased tissue of the skin such as epithelioma (cancer) and lupus (tuberculosis), there is the same sort of reaction; it is also found that the pathological tissues which are composed of growing cells, often of embryonic type, react in the same way as the active sensitive tissues of the normal skin. They are more sensitive to the effects than the stroma in which they are growing, disintegrate or degenerate readily, and are destroyed before or without destruction of the connective tissue around them.

It is evident in this process that we are dealing with an agent whose results are produced by influencing the biological processes of the cells themselves. The effects are not produced by an immediate destructive action of the rays, as a heat burn, for example, is produced. There is no immediate effect from the application of radium; it is only after days, it may be two or three weeks, that the effects appear. The inference is that the radiations set up some process in the tissues which itself ends in their destruction. The whole process is one of exaggerated stimulation of the activity of the cells of the tissues: a stimulation which varies in degrees with the degree of specialization or functional activity of the different type of cells. In its slightest degrees it is the ordinary protective process that occurs under exposure to sunlight, but under the unusual and extreme irritation of this artificial form of radiant energy the reaction becomes destructive.

Since the effects of radium have had therapeutic application, it may be interesting to pause to consider briefly this aspect of the subject.

As I have suggested, the effects of radium to a degree are selective in that they excite the intensest reaction in the cells of great functional activity whether this be in the exercise of a special function or the simpler function of growth. Thus there is produced by radium: (1) A stimulation of the cells; (2) an exaggerated effect upon the highly specialized structures of the epidermis, viz., the hair follicles, and the sebaceous and sweat glands, and likewise upon the basal or germinal layer; (3) an endarteritis or proliferation of the lining membrane of the blood vessels which may lead to obliteration of many blood vessels; (4) destruction of masses of diseased tissues, which are composed of young growing cells or immature cells.

These effects upon tissues suggest the possible use of radium for various therapeutic purposes, as follows: (1) To stimulate chronic processes. This principle has been successfully used in the treatment of some chronic inflammatory processes in the skin. (2) To destroy or diminish the follicles of the skin, particularly the hair follicles. This principle has had practical application with X-rays, but because of the small quantities available, not with radium, except in the case of hairy nævi (birthmarks). (3) To obliterate blood vessels in the skin. This has had practical application, with very successful results, in the treatment of vascular nævi (birthmarks). (4) To destroy pathological tissues. This use is of course possible of wide application, and has been successful in various diseases of the skin and the adjacent underlying structure, especially in carcinomas and sarcomas (cancers). Its limitation in cancer is that it is only effective upon such

lesions as can be directly exposed. As the action is to a degree selective, radium and X-rays have had very valuable practical uses in these diseases. (5) Finally the anodyne effect of radium has had some application in the relief of itching and of pain.

The therapeutic uses of radium are obtained from the above indications. The indications which might seem to be derived from the effect upon other organisms, especially upon bacteria, yet to be considered, have not increased the practical application of the agent.

Experiments upon other mammals have added little to the facts given above. Experiments on rabbits have shown that exposure to the radiations causes anesthesia in peripheral nerves (Beck), confirming a fact established by clinical experience. Danysz and Bohn have shown that the nervous system of certain young animals is peculiarly sensitive to the effects of radium, exposures so arranged as to reach strongly the cerebro-spinal axis causing paresis, ataxia, convulsions and death. These phenomena, with negative controls, were elicited in mice, which proved most sensitive, and in guinea pigs and rabbits. The sensibility is very much greater in the very young animals, persists in older mice, but disappears in great degree in adult guinea pigs and rabbits. Similar effects upon the nervous system of man from either radium or X-rays do not occur.

I can not take more than enough time to refer very briefly to the effects of radium upon micro-organisms, upon development and upon plants. The knowledge upon these subjects has been carefully summarized in a paper by Hussakof, of Columbia University, which is readily available.

Several experiments have shown the inhibitive or, under stronger exposures, destructive, effect of radium rays upon various bacteria in cultures—the bacillus prodigiosus, colon bacillus, typhoid bacillus, anthrax bacillus and the spirillum of cholera. These are the only biological findings differing from those with X-rays, and are probably due to the greater superficial effect of the alpha and beta rays because of their very slight penetration as compared with the softest X-rays. They indicate a close similarity, with a difference chiefly in degree, in their biological effects between alpha and soft beta rays and ultra-violet rays.

Similar results have been obtained by several observers from exposures of numerous forms of protozoa. Their growth is at first stimulated, then inhibited, and after intense exposures they are destroyed.

Experiments on various eggs, embryos and larvæ have shown, as would be expected, in these embryonic tissues, a high degree of susceptibility. Growth is retarded, monstrosities develop, and, from prolonged exposure, death occurs.

In plants the results of experiments may be summarized briefly as first stimulation of growth, and under stronger application, retardation or complete inhibition of growth.

This consideration has been directed to the effects of radium rays. As to the emanations, it may be stated briefly that experiments with the emanations upon young mice, upon bacteria, and upon protozoa show results quite like those from exposure to the rays.

There is apparently no difference in kind in the effects upon tissues between the different radium rays. Alpha rays have so little penetration that their effect is expended entirely upon the most superficial tissues, but when they are screened out the only difference in the reaction is one of intensity and depth. Exner, in a repeated experiment, by deflecting the beta rays with an electro-magnet directed them upon one white mouse while the gamma rays fell upon another mouse equidistant from the radium. Fifteen days after exposure, which had been for 18⅔ hours, a similar ulceration appeared on the tails—the exposed areas—in both mice. All three forms of radium rays then, are physiologically active. This fact might fairly be inferred from their actinic properties. For the physiological effects of all forms of radiant energy, there seems every reason to

believe, are a manifestation of the same actinic effects that we have long been familiar with in certain inorganic substances. Indeed, beginning with the red rays of light at one end of the scale and ending with the hardest X-rays and gamma rays at the other, we find physiological effects differing chiefly in degree and corresponding in intensity with the actinic strength of the respective rays.

What the bio-chemical processes are that are set going by radium, or by the more familiar forms of actinic energy, we are in no position to say. From experiments with radium upon eggs Schwartz proposed that all of the effects of radium upon tissues were due to decomposition of lecithin. Hussakof suggests from experiments of Willcock, Zuelzer and Körnicke that oxygen in some not understood way seems to play a part in the process. There is every reason to believe that the process is not explicable by any simple chemical reaction. Radium rays do not produce an immediate effect upon living tissues, similar to the reduction of silver salts, for example. They have an effect upon the life processes of the cells, and these after a relatively long time produce the results that we recognize as a radium reaction. In other words the process is a vital process, and one, doubtless, involving all of the chemical complexity of cell life itself.

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WM. ALLEN PUSEY
UNIVERSITY OF ILLINOIS

SPECIAL ARTICLES

ON THE CLASSIFICATION OF SAND GRAINS

PROFESSOR W. H. SHERZER has just published an important paper containing a classification of sands[1] in which a successful attempt is made to use origin as the primary factor for determining subdivisions. I say successful, because I believe Sherzer's classification to be a sound one for the reason that it is a natural one. In detail, as he himself says, it requires further amplification, but I believe that its leading features will stand. He distinguishes the following types: (1) *Glacial sand type,* (2) *volcanic sand type,* (3) *residual sand type,* (4) *aqueous sand type,* (5) *æolian sand type,* (7) *organic sand type,* (8) *concentration sand type.* The first five of these are clastic, the others are non-clastic. To the clastic he might have added as number 6 the artificially produced sands (or mechanico-organic) which no classification can afford to neglect, and to the non-clastic might be added, for completeness sake, (9) the granular snow and the firn or nevé, precipitated from the atmosphere, and (10) lapilli of igneous origin, but not pyroclastic. With the glacial sand group (1) Sherzer compares those formed by avalanches and rock slides, by rock and mud flows, and by earth movements along joint planes, *i. e.,* the familiar fault sand. He also adds the sand produced in the manufacture of talus, but this, when not due to mechanical slipping, clearly belongs under his residual type.

As thus included, the mechanical abrasion sands: glacial, fault, etc., come under the heading of *autoclastic sands,* and the series given by Sherzer, with the addition of the artificial sands, corresponds exactly to subdivisions of clastic rocks which I published in 1904,[2] as shown in the following table, where the corresponding divisions of my

[1] W. H. Sherzer, "Criteria for the Recognition of the Various Types of Sandgrains," *Bull. Geol. Soc. America,* Vol. 21, No. 4, pp. 625–662, pls. 43–47.

[2] A. W. Grabau, "On the Classification of Sedimentary Rocks," *American Geologist,* Vol. 23, pp. 228–247, April, 1904.

classification are numbered to agree with Sherzer's types. The technical terms for the mechanical types of the second column make for uniformity as well as euphony, while lending themselves readily to compounding.

A. CLASTIC SANDS

(Exogenetic)

Sherzer's Types of Sands

1. Glacial, etc., sand.
2. Volcanic sand.
3. Residual sand.
4. Aqueous sand.
5. Æolian sand.
6. (Artificial sand) added.

Corresponding Divisions in Grabau's Classification

1. Autoclastic sand or *autoarenyte.*
2. Pyroclastic sand or *pyrarenyte.*
3. Atmoclastic sand or *atmoarenyte.*
4. Hydroclastic sand or *hydrarenyte.*
5. Anemoclastic sand or *anemoarenyte.*
6. Bioclastic sand or *bioarenyte.*

B. NON-CLASTIC SANDS

(Endogenetic)

Sherzer's Types of Sands

7. Organic sand.
8. Concentration sand.
9. (Snow and firn sand) added.
10. (Lapilli or igneous sand) added.

Corresponding Divisions in Grabau's Classification

7. Biogenic sand.[3]
8. Hydrogenic sand.[3]
9. Atmogenic sand.[3]
10. Pyrogenic sand.[3]

In my classification of sedimentary rocks, I pointed out that after the determination of the agent, the further subdivision of clastic rocks must be on the basis of texture, and that three textures are to be recognized as of primary importance, namely, (1) *rudaceous texture,* the texture of rubble or material coarser than sand (*i. e.,* approximately above 2 to 2.5 mm.), (2) *arenaceous texture* or the texture of sand (2.5 to .05 mm.) and (3) *lutaceous texture* or the texture of mud, *i. e.,* rock flour, clay, etc. These three types of texture produce rocks, consolidated or unconsolidated, which may be classified as *rudytes, arenytes* and *lutytes,* respectively. Rudytes and lutytes are found in each of the divisions in which arenytes are found; we have *autorudytes* and *autolutytes, hydrorudytes, hydrolutytes* and all the rest, just as we have the various arenytes given above. Sherzer too is fully of the opinion that the coarser- and finer-than sand particles should be classified on the same basis as the sand itself.

Non-clastic, granular material constitutes sands, etc., only in the broader or popular sense of the term; while it is quite proper to speak of organic or chemical sands, it is desirable that the technical terms arenyte, lutyte, etc., be restricted to clastic rocks only.

Professor Sherzer further subdivides his types on the basis of reworking by some other agent. Thus he has an aqueo-residual type in which grains originally of residual (atmoclastic) origin are reworked by water. On the other hand, a residuo-aqueous type is one in which original aqueous sands (hydroclastic) have become weathered under the influence of the atmosphere. These two subtypes may be termed, respectively, the *hydro-atmoclastic* and the *atmohydroclastic* subtypes of sands. In like manner the other combinations may occur and we may have *anemohydro-,* atmo- and autoclastic sands, *hydro-anemo-,* atmo-, pyro- and autoclastic sands, *anemo-atmo-,* hydro-, pyro- and autoclastic sands, terms which have at least the advantage of euphony over the English equivalents, such as æolo-aqueous or residuo-æolian. But the selection of terms is a minor matter, the important thing being the correct classification on a genetic basis, and this Professor Sherzer has done for sands. I am happy to find myself so fully in accord with him, and that in the endeavor to classify materials he has come to substantially the same results that I have reached in approaching the matter from the more theoretical basis of principles of classification.

It may perhaps be questioned if the secondarily enlarged æolian sand grains which Professor Sherzer claims as concentro-æolian should be included in this classification, which is essentially one of the material in its orig-

[3] These are not arenytes in the sense used above —*i. e.,* for clastics only.

inal or unaltered form, while secondary enlargement of sand grains is a diagenetic process and so belongs to the subject of metamorphism.

Primarily the question is one of the admissibility of the non-clastic or endogenetic granular deposits to the group of sands, even in a popular sense. We would hardly speak of a bed composed of *Stromatopora* heads as a boulder bed, although when subject to wear on the margin of a reef the original purely organic (biogenic) mass passes into a hydrorudyte. In like manner the purely biogenic or hydrogenic granular or powdery accumulations (bioliths and hydroliths) may be transformed into clastics by one or another of the exogenetic agencies. Thus a purely biogenic (phytogenic) or a chemical (hydrogenic) oolite may become an æolian or anemoclastic rock and the same is often true of foraminiferal or molluscan shell accumulations, as in the cases cited by Sherzer.

It would be advantageous if we could restrict the use of the term arenyte to sands of clastic origin, *i. e.,* destructional sands in which the texture is *arenaceous,* and use some such term as *granulite* for constructional sand rocks in which the texture is *granulitic.* Such sands of organic (biogenic) origin form *biogranulites;* of concentrational (hydrogenic) origin (chemically formed oolites), *hydrogranulites* or, as in the case of granular snow of atmospheric (atmogenic) origin, *atmogranulites. Pyrogranulites* may be taken as another type, illustrated by lapilli, which can not be considered as truly clastic as in the case of volcanic sand. Coarser-than-sand masses of endogenetic origin might be classed as *spherites,*[1] and finer as *pulverites.* We may thus speak of *biospherites* and *biopulverites, hydrospherites* and *hydropulverites, pyrospherites* (volcanic bombs), etc., and should thus have our deposits of clastic and non-clastic materials classified by texture. Thus a *Stromatopora* bed or one made up of *Girvanella* would be a *biocalcispherite,* an organic oolite or a sand of small shells would be a *biocalcigranulite,* while common chalk would be classified primarily as a *biocalcipulverite.* A biocalcigranulite may be subject to wind action and so become a hydroclastic biocalcigranulite. It would ultimately pass into an anemocalcarenyte. It might be objected that such terms are too complex and difficult, but only a slight examination will show that they consist of logical combinations of a few easily comprehended terms. When understood, it will be conceded that such terms make for precision not only in expression, but also in thinking.

While I thus would urge the improvement of the terminology, I fully agree with Sherzer as to the principles on which his classification is based. I would merely again emphasize the importance of making a primary division into clastic (exogenetic) and non-clastic (endogenetic) sands and I would suggest the addition to the former of the division of bioclastic (chiefly the artificial sands) and to the latter the atmogenic snow and hail, and the pyrogenic sand or lapilli.

A. W. GRABAU
COLUMBIA UNIVERSITY

[1] There is no danger of confounding this with the mineral sphærite.

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

THE 454th regular and annual meeting of the society was held in the hall of the Public Library, April 18, 1911, 8 P.M., with the president, Dr. Fewkes, in the chair. The following were elected officers for the ensuing year:

President—Mr. F. W. Hodge.
Vice-president—Dr. J. R. Swanton.
Secretary—Dr. T. Michelson.
Treasurer—Mr. J. N. B. Hewitt.
Additional Members of the Board of Managers—Messrs. G. C. Maynard, G. R. Stetson, E. T. Williams, W. H. Babcock and Dr. E. L. Morgan.

It was voted to hold bi-weekly meetings at 4:45 P.M. on Tuesdays in the new National Museum instead of once a month at 8 P.M. as formerly; evening meetings to be held as the board of the society shall desire.

There was a joint meeting of the Washington Anthropological Society and the Medical Society of the District of Columbia at the New Masonic Temple on May 3, 1911, at 8 P.M. with Dr. Barton, president of the Medical Society, in the chair.

Drs. Hrdlička and Lamb each read a paper and exhibited specimens illustrating the diseases of pre-Columbian inhabitants of the western hemisphere. Dr. Hrdlička's paper was based on his explorations in Peru. The speaker pointed out that among the skeletal material there was not a single instance of rachitis. There was one case which may have been tuberculosis, but the evidence was not absolutely conclusive and the age of the grave (at Chicama) was unknown. Two burials were encountered in which the bones were undeniably syphilitic, but both these graves were among the more recent and likely post-Columbian. Thirty other long bones had more or less marked inflammatory alterations which might have been syphilitic, but the diagnosis could not be made with certainty. An examination of the many thousands of long bones determined that a very large majority of them had no lesions whatever. Only two of the 3,400 skulls brought away, presented a case of ulceration or a lesion that could be attributed with confidence to syphilis. In the Chicama cemeteries and to a lesser extent in those of Pachamac, there was marked rarity in the fractures of bones. The setting was generally defective. The wounds of the skull, especially at Pachamac, were very numerous. There was but one positive case of trephining, at Pachamac; but there were several skulls in which it is impossible to say whether they are examples of partially healed wounds from clubs or scars from trephining.

Dr. Lamb's paper was based on the collections of the Army Medical Museum. The specimens numbered nearly 250 and with few exceptions were abnormal, showing some anomaly, disease or injury. They come from the United States, Alaska and Peru. Anomalies such as the olecranon perforation, pilasteric femur, platyknemic tibia and deep channelling of the concave surfaces of the bones of the forearm and leg, were abundant, suggesting always a primitive people or a people of low type. There are many fractures, usually well healed but with deformity; among them two showing false joints. Many of the specimens had inflammation of the bone, hyperostosis, exostosis, osteomyelitis, osteitis deformans; and a few dislocations. Some showed bone syphilis, but none tuberculosis.

Both papers were discussed at length. Among the speakers were Drs. Lamb, Kober, La Gard, Carr, Shands, Michelson.

T. Michelson,
Secretary

The Society of Research Workers in Experimental Biology and Medicine, Washington, D. C.

The last meeting of this society for the season was held on May 27, 1911, at the University Club.

On this occasion Dr. William Salant, chief of the Division of Pharmacology, Bureau of Chemistry, U. S. Department of Agriculture, read a paper, "On the Action of Drugs under Pathological Conditions." Particular emphasis was placed on the fact that the present-day method of determining the action of drugs upon normal animals does not always show how the drug under examination will act under pathological conditions.

This meeting closed the third year of the existence of this society, which is comprised of members of the various scientific laboratories in Washington, D. C. (U. S. Public Health and Marine Hospital Service, the Bureaus of Chemistry, Plant Industry, Soils and Animal Industry of the U. S. Department of Agriculture, the Geophysical Laboratory of the Carnegie Institution and the U. S. Naval Medical School), and which has no regular officers except the chairman, who is chosen for each season. Dr. Heinrich Hasselbring, of the Bureau of Plant Industry, U. S. Department of Agriculture, has been elected as chairman, vice Salant, for the coming year.

Lewis W. Fetzer

The American Chemical Society New York Section

The ninth regular meeting of the session of 1910–11 was held in Rumford Hall on June 9. Professor Chas. Baskerville in the chair.

The following papers were presented:

"Determination of Copper: a Modification of the Iodine Method," E. C. Kendall.

"Report of the Sub-committee on Glycerine Analysis," A. C. Langmuir.

"Consistency of Paint by the Stormer Viscosimeter," Allen Rogers.

"Fish Oil as a Paint Vehicle," Maximilian Toch.

"Studies on the Reduction of Ferric and Ceric Salts" (read by title), Morris Loeb and S. R. Morey.

"An Equilibrium in the Cobaltamines," A. B. Lamb and J. W. Marden.

"Chemistry of Anæsthetics. IV., Chloroform," Chas. Baskerville and W. A. Hamor.

C. M. Joyce,
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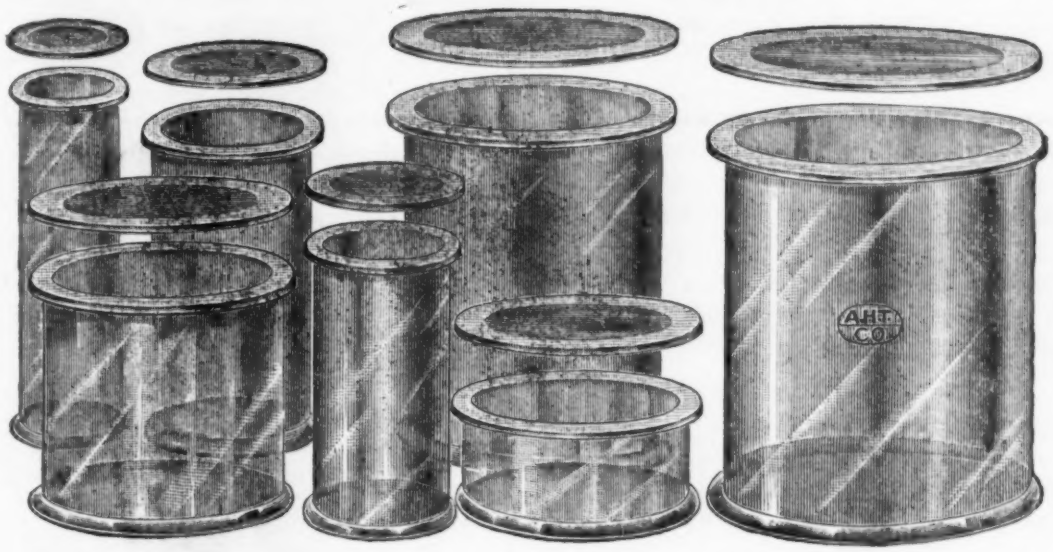

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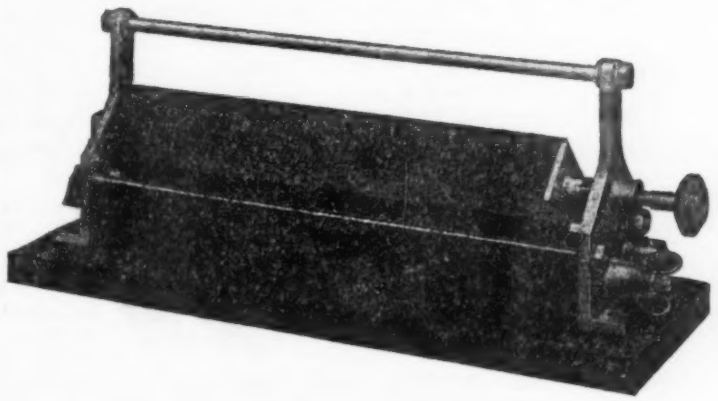

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University of Michigan

Department of Medicine and Surgery

Next Session begins October 3, 1911

The equivalent of two years' work in the Department of Literature, Science, and the Arts in this University are required for admission to this school, same to include chemistry, biology, physics, rhetoric, and French or German.

Six-year course leading to the degrees of B.S. and M.D. or seven year course leading to A.B. and M.D. are offered.

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For announcement and further information, address

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The annual announcement will be sent on application to the Director, Marine Biological Laboratory, Woods Hole, Mass.

UNIVERSITY OF MINNESOTA
COLLEGE OF MEDICINE AND SURGERY

Minimum Admission Requirements

Two full years of college work including two years of chemistry and one year each of physics, biology and modern language.

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Seven year course leading to the degrees of B.A. and M.D. Three years in the College of Science, Literature and the Arts or the equivalent, and four years in medicine. Other academic colleges of equal standing may affiliate on the same terms. Carleton and Macalester Colleges are so affiliated.

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